Influence of grain shape on grain rotation under Coble creep

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Abstract

The objective of the present study is to gain some insight into the physics of Coble creep based on the observation and the modeling of the microscopic deformation field. Recent advancements in Electron Backscatter Diffraction (EBSD) and Digital Image Correlation (DIC) have indeed enabled detailed experimental investigations of grain shape evolution and lattice rotations in deformed polycrystalline materials (1).
At elevated temperatures and/or low deformation rates, the sliding of neighboring grains along their boundaries may be accommodated by atomic diffusion along GBs, while maintaining the grain interior rigid. Inspired from previous work (2), an original variational approach is developed to model Coble creep over periodic crystalline aggregates. The model simulates GB sliding and GB diffusion mechanisms while considering grains of varying shapes and sizes, and while testing different assumptions about the threshold shear stress allowing GB sliding. It is demonstrated that the predicted macroscopic viscosity and the grain rotation rates tend to reproduce experimental trends.

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